APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/056,437	01/23/2002	Taehee Cho	02-112	8267

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EXAMINER
LEE, SHUN K

ART UNIT	PAPER NUMBER
2878	

DATE MAILED: 06/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

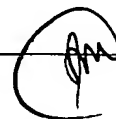|	Application No.	Applicant(s)
Office Action Summary	10/056,437	CHO ET AL.
	Examiner	Art Unit
	Shun Lee	2878

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE _3_ MONTH(S) FROM
THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed
  after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any
  earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on _04 April 2005 and 04 May 2005_.

2a)☐ This action is **FINAL**.   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is
closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) _1-19_ is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) _1-19_ is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on _1/23/2002 and 9/9/2004 and 3/2/2005_ is/are: a)☒ accepted or b)☐ objected to by the
Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☐ All   b)☐ Some * c)☐ None of:

      1.☐ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☐ Copies of the certified copies of the priority documents have been received in this National Stage
application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1.   A request for continued examination under 37 CFR 1.114, including the fee set

forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this

application is eligible for continued examination under 37 CFR 1.114, and the fee set

forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action

has been withdrawn pursuant to 37 CFR 1.114. Applicant's submissions filed on

2 March 2005 and 4 April 2005 have been entered.

Information Disclosure Statement

2.   The listing of references in the specification is not a proper information disclosure

statement. 37 CFR 1.98(b) requires a list of all patents, publications, or other

information submitted for consideration by the Office, and MPEP § 609 A(1) states, "the

list may not be incorporated into the specification but must be submitted in a separate

paper." Therefore, unless the references have been cited by the examiner on form

PTO-892, they have not been considered.

Drawings

3.   The drawings were received on 2 March 2005. These drawings are acceptable.

Specification

4.   The lengthy specification has not been checked to the extent necessary to

determine the presence of all possible minor errors. Applicant's cooperation is

requested in correcting any errors of which applicant may become aware in the

specification.

Claim Objections

5.   Claims 1, 3, 5-9, 11, 14, 17, and 19 are objected to because of the following

informalities:

    (a) in claim 1, "lights" on line 9 should probably be --light--;

    (b) in claim 3, "lights" on line 7 should probably be --light--;

    (c) in claim 5, "the at least one impurity-containing layer" on lines 2-3 should probably

       be --at least one impurity-containing layer--;

    (d) in claim 6, "the at least one impurity-containing layer" on line 2 should probably be

       --at least one impurity-containing layer--;

    (e) in claim 7, "the at least one impurity-containing layer" on line 2 should probably be

       --at least one impurity-containing layer--;

    (f) in claim 8, "the at least one impurity-containing layer" on line 2 should probably be

       --at least one impurity-containing layer--;

    (g) in claim 9, "the at least one impurity-containing layer" on line 2 should probably be

       --at least one impurity-containing layer--;

    (h) in claim 11, "the at least one impurity-containing layer" on line 3 should probably

       be --at least one impurity-containing layer--;

    (i) in claim 14, "the at least one impurity-containing layer" on line 3 should probably

       be --at least one impurity-containing layer--;

    (j) in claim 17, "the at least one impurity-containing layer" on line 3 should probably

       be --at least one impurity-containing layer--;

    (k) in claim 19, "lights" on line 8 should probably be --light--;

(l) in claim 19, "a contact layer" on line 10 should probably be --said contact layer--

(see "a contact layer" on line 9 in claim 19); and

(m) in claim 19, "electrode" on line 12 should probably be --electrodes--.

Appropriate correction is required.

Claim Rejections - 35 USC § 103

6.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7.   This application currently names joint inventors. In considering patentability of

the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein

were made absent any evidence to the contrary. Applicant is advised of the obligation

under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was

not commonly owned at the time a later invention was made in order for the examiner to

consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g)

prior art under 35 U.S.C. 103(a).

The specification discloses (pg. 20, lines 6-16) that "Once carriers are released

from the quantum dot layer by absorbing photons, the carriers with electric charges (i.e.,

negative for electron) move spatially to the channel layer (conduction path layer) and

the resulting vacancy in the quantum dot causes electric potential changes around the

quantum dot region including the channel region. This is also the very reason why the

quantum dots are placed near the channel in the present invention. The term "near the channel" means a distance wherein the quantum dots influence the potential of the channel by accumulating carriers in the channel layer". Thus within the context of the specification, the claim limitations "predetermined positions near" and "located near" is a distance that the photogenerated carriers can transit so as to accumulate in the channel (and there is an electric potential change in the channel due to the electric potential of the accumulated photogenerated carriers and the electric potential of the quantum dot vacancies).

8.   Claims 1-3, 5-10, 13, and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Iafrate *et al.* (US 4,821,093) in view of Romero *et al.* ("An analytical model for the photodetection mechanisms in high-electron mobility transistors", *IEEE Transactions on Microwave Theory and Techniques*, Vol. 44, no. 12, (December 1996), pp. 2279-2287) and Esaki *et al.* (US 5,079,601).

In regard to claims **1** and **2**, Iafrate *et al.* disclose a materialization method of a photo detect device, wherein channels for transferring carriers are set by heterointerfaces and impurity doping and magnitude of currents which flow through the channels is determined by controlling Fermi level (see gate electrode 28 in Fig. 1 and column 1, lines 18-49), comprising the steps of:

(a) forming at least one absorption layer at predetermined position proximate to the channels so as to influence the potential of the channels in such a manner that the for carriers in the at least one absorption layer to be released in response to incident light and accumulated in the channels (column 7, lines 37-51); and

(b) providing the Fermi level at an activation position by confining the carriers within

the at least one absorption layer while limiting the number of the carriers in the

channels for the purpose of minimizing a current flow in the absence of incident

light (column 7, lines 37-51).

The HEMT photodector of Iafrate *et al.* lacks an explicit description that carriers in a

contact layer are drawn to the channels until the vacancy of the at least one absorption

layer, which is originated by the release of carriers, is refilled by other carriers.

However, the photodectection mechanisms of HEMT photodetectors are known in the

art. For example, Romero *et al.* teach (last paragraph in the left column on pg. 2280;

Fig. 2) that charge neutrality is reestablished by electrons drawn from the external

circuit through the source contact. Therefore it would have been obvious to one having

ordinary skill in the art at the time of the invention that the photodectection mechanisms

of the HEMT photodector of Iafrate *et al.* include carriers being drawn to the channels

from the contact layer in order to reestablish charge neutrality (*i.e.*, the vacancy of the at

least one absorption layer, which is originated by the release of carriers, is refilled by

other carriers).

The method of Iafrate *et al.* also lacks that the at least one light absorption layer

comprise of at least one quantum dot layer which includes a plurality of quantum dots

for infrared (*i.e.*, wavelength from 0.77 µm to 100 µm) light detection. Esaki *et al.* teach

an absorption layer comprising of nanostructures which produce reduced dimensionality

electronic states (*e.g.*, quantum wells, quantum wires, quantum dots; column 8, lines

24-30) in order to have optical transition occurring between electron states in the

conduction band (or hole states in the valence band; column 2, lines 35-39) so as to

absorb light from the near to the far infrared (column 2, lines 26-29). Therefore it would

have been obvious to one having ordinary skill in the art at the time of the invention to

provide at least one light absorption layer comprising of quantum dots in the method of

Iafrate *et al.*, in order to detect light from the near (*e.g.*, 0.77 µm) to the far infrared (*e.g.*,

100 µm) as taught by Esaki *et al.*

In regard to claim **3**, Iafrate *et al.* disclose (Fig. 1) a photo detect device, wherein

channels for transferring carriers are set by heterointerfaces and impurity doping,

comprising:

   (a) at least one light absorption layer (12) located at predetermined positions

      proximate to the channels in at least one conduction path layer (30) for the carriers

      in the at least one light absorption layer (12) to be released in response to incident

      light and accumulated in the channels (column 7, lines 37-51);

   (b) the at least one conduction path layer (30), in which carriers excited in the light

      absorption layers (12) are collected and conducted in a horizontal direction which

      is parallel to the at least one conduction path layer (30);

   (c) at least two detect electrodes (24, 26) for conducting in the horizontal direction the

      carriers which are accumulated in the channels (30) in response to the light

      incident on the at least one light absorption layer (12); and

   (d) a contact layer (22) on which the detect electrodes (24, 26) are formed to collect

      and to provide the carriers for the at least one light absorption layer (12).

The HEMT photodector of Iafrate et al. lacks an explicit description that carriers are

drawn to the channels from the contact layer due to the potential of the channels which

are influenced by the carriers accumulating in the channels. However, the

photodectection mechanisms of HEMT photodetectors are known in the art. For

example, Romero et al. teach (last paragraph in the left column on pg. 2280; Fig. 2) that

charge neutrality is reestablished by electrons drawn from the external circuit through

the source contact. Therefore it would have been obvious to one having ordinary skill in

the art at the time of the invention that the photodectection mechanisms of the HEMT

photodector of Iafrate et al. include carriers being drawn to the channels from the

contact layer due to the potential of the channels which are influenced by the carriers

accumulating in the channels in order to reestablish charge neutrality.

The device of Iafrate et al. also lacks that the at least one light absorption layer

comprise of at least one quantum dot layer containing a plurality of quantum dots for

releasing carriers in response to the incident light, which is formed by alternating the

quantum dot layer and a material different in bandgap from the quantum dot layer.

Esaki et al. teach a light absorption layer comprising of nanostructures which produce

reduced dimensionality electronic states (e.g., quantum wells, quantum wires, quantum

dots; column 8, lines 24-30) in order to have optical transition occurring between

electron states in the conduction band (or hole states in the valence band; column 2,

lines 35-39) so as to absorb light from the near to the far infrared (column 2, lines

26-29). That is, Esaki et al. teach that a photon (with energy $\hbar\omega$) is absorbed in the

conduction band of a light absorption layer when an electron in an electron state with

energy E_1 makes an optical transition to an unoccupied electron state with energy E_2

($E_2 = E_1 + \hbar\omega$). Esaki *et al.* also teach that electron state with energy E_1 must be

populated with electrons in order for the optical transition to occur (*i.e.*, arrangement of

the band and Fermi levels, for example by applying a bias voltage, so that electrons

move from another layer into the electron state with energy E_1 of the absorption layer;

column 6, lines 59-63). Thus, Esaki *et al.* teach that the absorption layer with electron

state with energy E_1 should be populated with electrons and electron state with energy

E_2 should be unoccupied so that an optical transition can occurred in order to detect

light from the near to the far infrared. Also, modulation doping (*i.e.*, carriers supplied to

a layer by at least one impurity-containing layer) so as to provide carriers for the

electron state with energy E_1 is well known in the art. Therefore it would have been

obvious to one having ordinary skill in the art at the time of the invention to provide a

light absorption layer comprising of quantum dots with carriers supplied by at least one

impurity-containing layer in the device of Iafrate *et al.*, in order to detect light from the

near to the far infrared as taught by Esaki *et al.*

In regard to claim **5** which is dependent on claim 3, the device of Iafrate *et al.*

lacks that at least one impurity-containing layer is a delta-doped structure. Esaki *et al.*

teach that the absorption layer with electron state with energy E_1 should be populated

with electrons and electron state with energy E_2 should be unoccupied so that an optical

transition can occurred in order to detect light from the near to the far infrared (see

above). Inherent in Esaki *et al.*'s teachings is that enough electrons must be provided

to the absorption layer in order to populate electron state with energy E_1 while leaving

electron state with energy E_2 unoccupied. Thus, number of impurities in the

impurity-containing layers is determined by the number of electrons needed to populate

electron state with energy E_1 while leaving electron state with energy E_2 unoccupied.

Impurity-containing layers with a delta-doped structure are well known in the art.

Therefore it would have been obvious to one having ordinary skill in the art at the time

of the invention to provide impurity-containing layers with a delta-doped structure in the

device of Iafrate et al., in order to supply carriers from impurity-containing layers to the

absorption layer so as to detect light from the near to the far infrared as taught by

Esaki et al.

In regard to claim **6** which is dependent on claim 3, the device of Iafrate et al.

lacks at least one impurity-containing layer having a uniform distribution of the impurities

therethrough and are etched to control the number of carriers provided to the quantum

dots. Esaki et al. teach that the absorption layer with electron state with energy E_1

should be populated with electrons and electron state with energy E_2 should be

unoccupied so that an optical transition can occurred in order to detect light from the

near to the far infrared (see above). Inherent in Esaki et al.'s teachings is that enough

electrons are provided to the absorption layer in order to populate electron state with

energy E_1 while leaving electron state with energy E_2 unoccupied. Thus, number of

impurities in the impurity-containing layers is determined by the number of electrons

needed to populate electron state with energy E_1 while leaving electron state with

energy E_2 unoccupied. The number of electrons supplied by impurity-containing layers

is determined by the number of impurities. For a uniform distribution of the impurities,

the number of impurities is equal to the density of impurities times the volume of the

impurity-containing layers. Thus, the number of electrons supplied by

impurity-containing layers is determined by the density of impurities and the volume of

the impurity-containing layers. Therefore it would have been obvious to one having

ordinary skill in the art at the time of the invention to provide impurity-containing layers

with a uniform distribution of the impurities and an adjusted volume (e.g., by etching) in

the device of Iafrate et al., in order to supply carriers from impurity-containing layers to

the absorption layer so as to detect light from the near to the far infrared as taught by

Esaki et al.

In regard to claims **7** and **8** which are dependent on claim 3, Iafrate et al. also

disclose (Fig. 1) impurity-containing layers (14) and light absorption layers (12) formed

adjacent (e.g., overlapped) to conduction path layers (30).

In regard to claim **9** which is dependent on claim 3, Iafrate et al. also disclose

that the impurity-containing layers and the light absorption layer are made to have

different band gaps so as to be subjected to heterostructures (i.e., heterojunction;

column 1, lines 18-49). While Iafrate et al. further disclose that the conducting path

layers is in the form of a two-dimensional electron gas (column 1, lines 18-49), the

device of Iafrate et al. lacks an explicit description that the conducting path layers have

a different band gap so as to be subjected to heterostructures. However it is well known

in the art that two-dimensional electron gas occurs in a quantum well and that a

quantum well is formed by band gap differences. Therefore it would have been obvious

to one having ordinary skill in the art at the time of the invention to provide conducting

path layers made to a different band gaps in the device of Iafrate *et al.*, in order to form

a two-dimensional electron gas so as to have high electron mobility conducting paths as

taught by Iafrate *et al.* (column 1, lines 18-49).

In regard to claim **10** which is dependent on claim 3, Iafrate *et al.* also disclose

(Fig. 1) at least one control electrode (28) for controlling the amount of the carriers

provided to the light absorption layers (12) and the conduction path layers (30).

In regard to claims **13** and **16** which are dependent on claim 10, Iafrate *et al.* also

disclose a multiple gate high electron mobility field effect transistor in a photodetector

configuration (see Figs. 2 and 8; and column 7, lines 37-51).

9.   Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over

Iafrate *et al.* (US 4,821,093) in view of Romero *et al.* (*IEEE Trans. Microwave Theory*

Tech., Vol. 44, no. 12, (December 1996), pp. 2279-2287) and Esaki *et al.*

(US 5,079,601) as applied to claim 3 above, and further in view of Bethea *et al.*

(US 4,739,385).

In regard to claim **4** which is dependent on claim 3, the modified device of

Iafrate *et al.* lacks an explicit description of the distance between the detect electrodes.

Bethea *et al.* disclose that the detect electrodes (15, 19 in Fig. 1) have a distance

therebetween which is greater than 2.5 µm to 120 µm (column 3, lines 7-9) in order to

have good optical coupling efficiency (column 3, lines 13-16). Therefore it would have

been obvious to one having ordinary skill in the art at the time of the invention to provide

greater than 2.5 µm to 120 µm distance (*e.g.*, which is longer than a 0.77 µm incident

light wavelength) between the detect electrodes in the modified device of Iafrate *et al.*,

in order to have good optical coupling efficiency as taught by Bethea *et al.*

10.   Claims 11, 12, 14, 15, 17, and 18 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Iafrate *et al.* (US 4,821,093) in view of Romero *et al.* (*IEEE Trans.*

Microwave Theory Tech., Vol. 44, no. 12, (December 1996), pp. 2279-2287) and

Esaki *et al.* (US 5,079,601) as applied to claims 10, 13, and 16 above, and further in

view of Schiebel *et al.* (US 5,396,072).

In regard to claims **11** and **12** (which are dependent on claim 10), claims **14** and

15 (which are dependent on claim 13), and claims **17** and **18** (which are dependent on

claim 16), the modified device of Iafrate *et al.* lacks a layer (*e.g.*, doped or highly

resistant) provided below a bottom layer of the control electrodes to reduce leak

currents of the control electrodes. The use of layers (*i.e.*, blocking layers) overlapping

electrodes to block charge injection from the electrode (*i.e.*, leakage current) is well

known in the art. For example, Schiebel *et al.* teach to provide a layer overlapping a

electrode which is substantially not conductive to carriers of: (a) both polarities (column

3, lines 45-49) or (b) same polarity relative to the potential of electrode (column 3, lines

32-36). For example, for an electrode which will have both negative and positive

voltages applied, a highly resistant layer (*i.e.*, a layer which is substantially not

conductive to both electrons and holes) should be provided. As another example, for an

electrode which will have a negative voltage applied, a p-type layer (*i.e.*, a layer which is

substantially not conductive to electrons) should be provided. Therefore it would have

been obvious to one having ordinary skill in the art at the time of the invention to provide

a blocking layer below the control electrodes in the modified device of Iafrate *et al.*, in

order to reduce leakage currents as taught by Schiebel *et al.*

11.   Claim 19 is rejected under 35 U.S.C. 103(a) as being unpatentable over

Iafrate *et al.* (US 4,821,093) in view of Romero *et al.* (*IEEE Trans. Microwave Theory*

Tech., Vol. 44, no. 12, (December 1996), pp. 2279-2287), Esaki *et al.* (US 5,079,601),

and Chapple-Sokol *et al.* (US 5,293,050).

In regard to claim **19**, Iafrate *et al.* disclose a method for fabricating a photo

detect device, comprising the steps of:

(a) growing light absorption layers (column 7, lines 37-51), wherein said absorption

layer are located at predetermined positions proximate to channels for carriers in

the light absorption layers to be released from the light absorption layers in

response to incident light and accumulated in the channels (column 7, lines 37-

51);

(b) depositing at least two electrode on a contact layer to show horizontal conduction

(column 3, lines 3-5);

(c) reducing the resistance between the electrodes and the contact layer (column 2,

line 68 to column 3, line 2);

(d) etching the edge of the device to an extent necessary to reduce an electrical

connection to other neighboring devices (column 6, lines 11-15); and

(e) depositing at least one control electrode (column 3, lines 5-9).

The HEMT photodector of Iafrate *et al.* lacks an explicit description that carriers are

drawn to the channels from the contact layer. However, the photodectection

mechanisms of HEMT photodetectors are known in the art. For example, Romero *et al.* teach (last paragraph in the left column on pg. 2280; Fig. 2) that charge neutrality is reestablished by electrons drawn from the external circuit through the source contact. Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention that the photodectection mechanisms of the HEMT photodector of Iafrate *et al.* include carriers being drawn to the channels from the contact layer in order to reestablish charge neutrality.

The method of Iafrate *et al.* also lacks forming quantum dots naturally in the course of growing the light absorption layers, controlling the amount of carriers provided to the quantum dots by adjusting the contact layer and/or a carrier supplying layer volume and the control electrode voltage, and depositing and etching an insulating film over the device. However, insulating films for integrated circuits (*e.g.*, FET) are well known in the art. That is, it would have been obvious to one having ordinary skill in the art to at the time of the invention provide an insulating film (*e.g.*, by depositing and etching) in the method of Iafrate *et al.*, in order for the device to function properly (*e.g.*, electrical isolation between different electrodes). In addition, Esaki *et al.* teach a light absorption layer comprising of nanostructures which produce reduced dimensionality electronic states (*e.g.*, quantum wells, quantum wires, quantum dots; column 8, lines 24-30) in order to have optical transition occurring between electron states in the conduction band (or hole states in the valence band; column 2, lines 35-39) so as to absorb light from the near to the far infrared (column 2, lines 26-29). That is, Esaki *et al.* teach that a photon (with energy $\hbar\omega$) is absorbed in the conduction band of

a light absorption layer when an electron in an electron state with energy E_1 makes an optical transition to an unoccupied electron state with energy E_2 ($E_2 = E_1 + \hbar\omega$). Esaki *et al.* also teach that electron state with energy E_1 must be populated with electrons in order for the optical transition to occur (*i.e.*, arrangement of the band and Fermi levels, for example by applying a bias voltage, so that electrons move from another layer into the electron state with energy E_1 of the absorption layer; column 6, lines 59-63). Thus, Esaki *et al.* teach that the absorption layer with electron state with energy E_1 should be populated with electrons and electron state with energy E_2 should be unoccupied so that an optical transition can occurred in order to detect light from the near to the far infrared. Further, Chapple-Sokol *et al.* teach it is known in the art that quantum dots are naturally forming the growth of a photodetector (column 3, lines 4-38) for any type of photodetector (column 6, lines 36-39). Therefore it would have been obvious to one having ordinary skill in the art at the time of the invention to provide naturally formed quantum dots which are supplied with the appropriate amount of carriers by adjusting the carrier supplying layer volume and the control electrode voltage in the method of Iafrate *et al.*, in order to detect light from the near to the far infrared as taught by Esaki *et al.*

Response to Arguments

12.   Applicant's arguments filed 4 April 2005 have been fully considered but they are not persuasive.

Applicant argues (remarks filed 4 April 2005) that in the invention of Esaki *et al.*, the respective cladding electrodes are formed respectively at above and under portions

of the quantum structures (quantum wells) and the quantum structures are rapidly

refilled with electrons provided by the electrodes because the quantum structure layer is

very thin and the electrons are practically obstructed by nothing whereas in the present

invention, the probability of the carriers refilling the quantum dots is not so high because

many quantum dots formed in the quantum dot layer act as barriers to current flow. In

response to applicant's argument that the references fail to show certain features of

applicant's invention, it is noted that the features upon which applicant relies (*i.e.*, rate at

which carriers refill the quantum dots) are not recited in the rejected claim(s). Although

the claims are interpreted in light of the specification, limitations from the specification

are not read into the claims. See *In re Van Geuns*, 988 F.2d 1181, 26 USPQ2d 1057

(Fed. Cir. 1993).

Conclusion

13.   Any inquiry concerning this communication or earlier communications from the

examiner should be directed to Shun Lee whose telephone number is (571) 272-2439.

The examiner can normally be reached on Tuesday-Friday.

        If attempts to reach the examiner by telephone are unsuccessful, the examiner's

supervisor, David Porta can be reached on (571) 272-2444. The fax phone number for

the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the

Patent Application Information Retrieval (PAIR) system. Status information for

published applications may be obtained from either Private PAIR or Public PAIR.

Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should

you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).

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